

What is claimed is:

1. A multi-air conditioner comprising:

an outdoor unit installed at an outdoor location, and having therein a compressor, an outdoor heat exchanger, and an outdoor fan for ventilating the outdoor heat exchanger;

a plurality of indoor units installed at respective indoor rooms, each having therein an electronic expansion valve and an indoor heat exchanger;

a distributor provided between the outdoor unit and the plurality of indoor units, for selectively guiding a refrigerant introduced from the outdoor unit to the plurality of indoor units according to an operation condition;

a four-way valve provided on an outlet side of the compressor, for selectively switching a flow direction of the refrigerant flowing through the outdoor heat exchanger;

a selective expansion unit provided at a rear side of the outdoor heat exchanger, for selectively expanding the refrigerant according to the flow direction of the refrigerant;

a gas-liquid separator provided in the outdoor unit, for separating a vapor-phase refrigerant and a liquid-phase refrigerant from the refrigerant flowing out of the outdoor heat exchanger; and

a connection tube part having a first connection tube for connecting the four-way valve with a distributor, a second

connection tube for connecting an upper portion of the gas-liquid separator with the distributor to guide the vapor-phase refrigerant, and a third connection tube for connecting a lower portion of the gas-liquid separator with the distributor to guide the liquid-phase refrigerant.

2. The multi-air conditioner of claim 1, wherein the four-way valve selectively switches between a first connection state in which the outlet side of the compressor is connected with the outdoor heat exchanger and an inlet side of the compressor is connected with the separator, and a second connection state in which the outlet side of the compressor is connected with the distributor and the inlet side of the compressor is connected with the outdoor heat exchanger.

3. The multi-air conditioner of claim 1, wherein the selective expansion unit comprises:

a parallel tube connected between the outdoor heat exchanger and the gas-liquid separator;

a first check valve provided on one side of the parallel tube, for passing the refrigerant flowing from the outdoor heat exchanger toward the gas-liquid separator; and

a heating electronic expansion valve provided on the other side of the parallel tube, for expanding the refrigerant introduced into the outdoor heat exchanger.

4. The multi-air conditioner of claim 1, further comprising a bypass unit for guiding the refrigerant introduced through the second connection tube to the inlet of the compressor, in case a majority of indoor units operate in the heating mode while the rest operates in the cooling mode.

5. The multi-air conditioner of claim 4, wherein the bypass unit comprises:

a bypass tube for connecting the vapor-phase tube with a tube connecting between the four-way tube and the outdoor heat exchanger;

a first valve provided on the bypass tube, and opened only when the majority of indoor units operates in the cooling mode the rest operates in the heating mode; and

a second check valve provided on the second connection tube positioned between the gas-liquid separator and the bypass tube, for passing only the refrigerant flowing from the gas-liquid separator toward the separator.

6. The multi-air conditioner of claim 5, wherein the distributor comprises:

a guide tube part for selectively guiding the refrigerant introduced from the outdoor unit to the respective indoor units, and guiding the refrigerant heat-exchanged in the respective indoor units to the outdoor unit; and

a valve part for controlling a flow of the refrigerant in the guide tube part such that the refrigerant is selectively introduced into the respective indoor unit according to the operation condition.

7. The multi-air conditioner of claim 6, wherein the guide tube part comprises:

vapor-phase branch tubes branched from the second connection tube and connected to the indoor units, respectively;

liquid-phase branch tube branched from the third connection tube and connected to the indoor units, respectively; and

connection branch tubes connecting the first connection tube and the indoor units, respectively.

8. The multi-air conditioner of claim 7, wherein the valve part comprises a two-way valve provided in each of the vapor-phase branch tubes, each of the liquid-phase branch tubes, and

each of the connection branch tubes, and turned on or off according to the operation condition.

9. The multi-air conditioner of claim 8, wherein each electronic expansion valve provided in each of the indoor units is provided in each of the liquid-phase branch tubes connecting the indoor heat exchangers and the distributor.

10. The multi-air conditioner of claim 1, further comprising control means for controlling revolution times of the outdoor fan such that a mixed ratio of a vapor-phase refrigerant and a liquid-phase refrigerant introduced to the gas-liquid separator via the outdoor heat exchanger is controlled according to the operation condition.

11. The multi-air conditioner of claim 10, wherein the control means comprises:

a temperature sensor provided between the outdoor heat exchanger and the gas-liquid separator, for sensing a temperature of the refrigerant; and

a microcomputer for comparing the sensed temperature of the refrigerant with a predetermined temperature to calculate the mixed ratio of the refrigerant, and for controlling the revolution times of the outdoor fan to equalize the calculated

mixed ratio with the predetermined mixed ratio according to the operation condition, in case the indoor units all operate in the cooling mode, or in case a majority of indoor units operate in the cooling mode while the rest operates in the heating mode.

12. The multi-air conditioner of claim 9, wherein in case the indoor units all operate in the cooling mode or in case the majority of indoor units operate in the cooling mode while the rest operates in the heating mode, the four-way valve is switched to connect the outlet of the compressor with the outdoor heat exchanger and to connect the inlet of the compressor with the distributor.

13. The multi-air conditioner of claim 12, wherein in case the indoor units all operate in the cooling mode, the heating electronic expansion valve and the first valve are closed, the electronic expansion valves of the indoor units all operate, the two-way valves connected to the vapor-phase branch tubes are all closed, and the two-way valves connected to the connection branch tubes and the liquid-phase branch tubes are all opened.

14. The multi-air conditioner of claim 12, wherein in case the majority of indoor units operate in the cooling mode while the rest operates in the heating mode,

the heating electronic expansion valves and the first valve are closed,

in case of the indoor units operating in the cooling mode, the electronic expansion valves connected to the indoor heat exchangers operate, the two-way valves connected to the vapor-phase branch tubes are closed, and the two-way valves connected to the connection branch tubes and the liquid-phase branch tubes are opened, and

in case of the indoor units operating in the heating mode, the electronic expansion valves connected to the indoor heat exchangers are opened, and the two-way valves connected to the vapor-phase branch tubes, the liquid-phase branch tubes and the connection branch tubes are opened.

15. The multi-air conditioner of claim 9, wherein in case the indoor units all operate in the heating mode, or in case the majority of indoor units operate in the heating mode while the rest operates in the cooling mode,

the four-way valves are switched to connect the outlet of the compressor with the distributor and to connect the inlet of the compressor with the outdoor heat exchanger.

16. The multi-air conditioner of claim 15, wherein in case the indoor units all operate in the heating mode,

the heating electronic expansion valves operate, the first valve is closed, the electronic expansion valves of the indoor units are all opened, the two-way valves connected to the vapor-phase branch tubes are all closed, and the two-way valves connected to the connection branch tubes and the liquid-phase branch tubes are all opened.

17. The multi-air conditioner of claim 15, wherein in case the majority of indoor units operate in the heating mode while the rest operates in the cooling mode,

the heating electronic expansion valve operates and the first valve is closed,

in case of the indoor units operating in the heating mode, the electronic expansion valves connected to the indoor heat exchangers are opened, the two-way valves connected to the vapor-phase branch tubes are closed, and the two-way valves connected to the connection branch tubes and the liquid-phase branch tubes are opened, and

in case of the indoor units operating in the cooling mode, the electronic expansion valves connected to the indoor heat exchangers operate, the two-way valves connected to the vapor-phase branch tube and the liquid-phase branch tube are closed, and the two-way valves connected to the connection branch tube are opened.



18. The multi-air conditioner of claim 1, wherein the gas-liquid separator is provided between the selective expansion unit and the distributor.

19. An operation method of a multi-air conditioner, the method comprises the steps of:

in case indoor units all operate in a cooling mode, or in case a majority of indoor units operate in the cooling mode while the rest operates in a heating mode, switching a four-way valve such that a refrigerant discharged from a compressor is introduced into an outdoor heat exchanger; and

closing a heating electronic expansion valve, and

in case the indoor units all operate in the heating mode, or in case the majority of indoor units operate in the heating mode while the rest operates in the cooling mode,

switching the four-way valve such that a vapor-phase refrigerant discharged from the compressor is introduced into a first connection tube; and

operating the heating electronic expansion valve.

20. An operation method of a multi-air conditioner, the method comprises the steps of:

in case indoor units all operate in a cooling mode, or in case a majority of indoor units operate in the cooling mode while the rest operates in a heating mode,

sensing a temperature of a refrigerant using a temperature sensor; and

comparing the sensed temperature of the refrigerant with a predetermined temperature to detect a mixed ratio of the refrigerant in a tube; and

varying revolution times of an outdoor fan to equalize the detected mixed ratio with a predetermined mixed ratio.